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ON THE LEUCOCYTOSIS IN SCARLET FEVER.*

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IN the following observations an attempt has been made to verify the observations of previous writers, and further to note the amount of leucocytosis in different stages of scarlet fever, in different grades of severity of the disease, and also the effect of the various complications and sequelæ on the white blood count. Though there are changes in the various elements of the blood in scarlet fever, erythrocytes as well as leucocytes, it is to the condition of the white cells that I shall confine myself.

Pick, Halla, Rieder, and Kotschetkoff were among the first to report their observations in blood analysis of scarlet fever patients, and all were agreed on the constant presence of a leucocytosis. Their actual figures as to the intensity of the leucocytosis vary considerably, due no doubt to the varying intensity of the disease.

Kotschetkoff found, after examining the blood of twenty scarlatina patients, that the leucocytosis was directly proportionate to the severity of the cases, the variation lying between a minimum of 10,000 and a maximum of 40,000. The highest leucocytosis (40,000) he obtained in rapidly fatal cases. He found an early leucocytosis in all, reaching its height on the second or third day, then gradually decreasing to normal after six weeks. From his observations he concluded that neither temperature, lymphadenitis, otitis, nor nephritis had any effect on the number of leucocytes. In his cases the *überreiffen Formen*—the neutrophiles and eosinophiles—were increased in number to 85–98 per cent., but those having 95 per cent. or more of neutrophiles and eosinophiles ended fatally. These cells were found in greatest number on the second day of the rash, from which time on there was a daily decline to normal. After returning to normal, further complications had no influence on the count. In fatal cases the eosinophiles and neutrophiles remained at their maximum. Kotschetkoff found that the

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eosinophiles were increased, except in fatal cases, from the third day on till the third week, to as much as 15 per cent.

Zappert, from his studies on eosinophiles, concludes that in fevers, during the febrile intoxication, there is a fall in the eosinophiles. After the disappearance of the fever, the eosinophiles gradually ascend to normal. In scarlatina he agrees with Kotschetskoff in the early diminution of the eosinophiles, with a subsequent rise, reaching the maximum at the end of the third week.

Of the more recent writers on the subject, Sacquépée found that, in older patients, twenty to twenty-two years of age, the eosinophiles were increased early in the disease (fourth or fifth day), and the increase persisted for three or four weeks. The apparent increase in the mononuclears, he holds, is due to a more rapid decrease in number on the part of the polynuclears. Cervical adenitis and parotiditis, as complications of scarlatina, both show more or less leucocytosis. In fatal cases of scarlatina he observed a hyperleucocytosis with "abnormal" forms, which he found in none but malignant cases. The polynuclear cells, showing a decided acidophile nature, he regarded as degenerated eosinophiles.

Reckzeh found a maximum leucocytosis of 41,000, on the fourth to the ninth day. The decline in the number of leucocytes, he states, is gradual, and reaches its normal toward the third week. He found that adenitis, joint affections, and endocarditis each causes an increased leucocytosis. On the contrary, nephritis is followed by a decrease in the number of white cells. The lymphocytes are fewer at the onset, but later increase as the polynuclears decrease. The eosinophiles in his series varied from 1 to 12.5 per cent., reaching the maximum about the eighth day. He believes that the unknown scarlatinal toxin stimulates the blood-producing organs (as regards the leucocytes) to a greater activity, with a consequent increased white cell count.

Reckzeh gives a very full tabulated statement of the successive blood counts throughout the course of each of his ten cases, often as many as a dozen, and extending from the second or third day of the fever to the end of the fifth or sixth week. What appears to me not a little remarkable is that, in the majority of these

counts, he reports either a low count or a total absence of eosinophiles. This he does not refer to in his summing up, but, on the contrary, lays stress upon the eosinophilia. Judging from my observations, his "0" in many cases means either that he has failed to count the eosinophiles, or else that he has regarded the faintly stained, coarsely granular oxyphile cells among the neutrophiles. Reference to the plate accompanying this paper will, I think, establish that these are truly to be classed as eosinophiles proper.

Rille* observed that in two moderate cases of scarlatina the eosinophiles were moderate in number, though there was a leucocytosis varying from 8,800 to 18,200. In a fatal case he found the eosinophiles increased 5.3 to 7.77, with a leucocytosis of from 15,000 to 20,000.

Plantenga, comparing the results of his examinations of measles and *Rötheln* with those of scarlatina, concluded that a diagnostic point could be made of an early increase in the polynuclears in the two first-mentioned diseases. Reference to my tables does not support this view.

Mackie found in examining the blood of scarlet fever patients that the leucocytosis was marked in mild or moderate cases, while in unfavorable cases the leucocytosis was less marked or even absent.

While writing this article, after the completion of my observations, my attention was drawn by Dr. Hektoen to a singularly full and able paper on the subject by J. M. Bowie. Bowie examined many more cases than are taken up here, but I was very much struck with the similarity of his observations with those here given. What would appear to be discrepancies in our results I think can be explained by two facts: one, the constant variation in the intensity and nature of scarlatinal epidemics, and the other, our different classification of the varieties of the disease. No one will deny the great variation in the intensity and sequelæ to which scarlatinal epidemics are subject, which necessarily must also affect the leucocytosis. Bowie divides his cases into scarlatina simplex, scarlatina anginosa, and fatal cases. In the first group he considers only the mild, I presume uncomplicated, cases. In the second group he places all moderately severe

* Cited by Reckzeh.

cases, with and without complications. In my series, those spoken of as moderately severe I divide into two classes—the pure uncomplicated cases, and those with complications of adenitis, otitis, joint affections, and so on. Bowie also divides his fatal cases into two groups—“those that never recover from the primary shock of the fever, and those that make a bold bid for life, but die eventually from exhaustion and toxemia.” Two of the cases to be considered later come under the first heading; a third, under the second. I shall take up his paper more fully in the summary, and compare the results with the present observations.

Remembering the frequent discovery of streptococcal complications in this disease, it becomes worth while to note the observations made regarding the variations in the leucocytes in septic, and more particularly in streptococcal, disorders.

Cabot has tabulated a series of cases of septicemia, and found that forty-two out of fifty-six gave a leucocytosis varying from 9,000 to 77,500. The leucocytosis was of the polymorphonuclear type, with a disappearance of the eosinophiles and a diminution of the lymphocytes. He further reports the examination of three cases in which the streptococcus was isolated, and showing a varying leucocytosis of from 24,800 to 46,000.

Rieder notes in a fatal case of sepsis that the eosinophiles are wholly absent.

Residence in an infectious disease hospital (the Ottawa Isolation Hospital) gave me an opportunity of examining a series of fourteen cases of undoubted scarlatina. Only those cases were utilized in which the clinical history and symptoms indicated the unquestionable nature of the disease. As all the cases are from hospital practice, examinations were not obtained earlier than twelve hours after the onset; hence no results can be given as to the leucocytosis appearing during the incubation period.

The ages of the patients ranged from two and a half to fourteen years. The examination consisted in the estimation of the white cells per cubic millimeter, and the preparation of stained slides for the estimation of the relative count, and the minute detail of the cells.

The blood was obtained in the usual way from the lobe of the ear. The examinations were made late in the morning, usually just before noon, to obtain counts as nearly as possible under similar conditions, and eliminate the leucocytosis following digestion. The examination was made with a Thoma-Zeiss hemocytometer, using a 3 per cent. acetic acid solution, tinged with gentian violet, as a diluting medium. Three successive counts were made of the complete 400 squares each, making a total of 1,200 squares.

The films were made on coverslips and fixed in a mixture of equal parts of alcohol and ether, being stained later by the Nocht-Romanowsky method. For the determination of the relative numbers of white cells present at least 800 cells were counted. In studying the more minute structure of the cells a one-twelfth oil immersion lens and No. 5 ocular were used (Reichert).

As normally there is a considerably higher count of white cells in children than in adults, a leucocytosis was considered only in the presence of 10,000 or over per cubic millimeter. The normal adult differential count may be considered as,

	Per cent.
Lymphocytes - - - - -	22-25
Polymorphonuclear neutrophiles - - -	62-70
Eosinophiles - - - - -	0.5-4

In infancy and childhood the percentage of lymphocytes is higher (40-60 per cent.), and the polymorphonuclears are only 28-40 per cent. (Cabot).

The cases examined in these observations were: two cases of very mild scarlatina, nine of moderate severity, and three of malignant scarlatina, two of which died within three days after the onset. Among the cases of moderate severity were also those developing adenitis, otitis media, nephritis, and arthritis. In two patients, counts were obtained before and after the administration of antistreptococcic serum.

MILD SCARLATINA.

The diagnosis in these two cases rested mainly on the mode of onset, the presence of other cases of scarlet fever in the same family, and the subsequent desquamation.

In the very mild type of scarlet fever the white cells showed little or no change in number or relative count. This, then, resembles the condition found in pneumonia, where we also meet with a normal, or even subnormal, count during a mild attack. The highest count obtained in these two cases was 12,780 on the second day, while the lowest was 7,400. The differential counts were normal. The conditions here also bear a close resemblance to those seen in measles, where the count is always low.

Case I, female, <i>æ</i> t. 6—	2d day	-	-	-	12,780
	9th day	-	-	-	9,228
	11th day	-	-	-	10,740
	28th day	-	-	-	11,680
Case II, female, <i>æ</i> t. 2—	2d day	-	-	-	9,440
	12th day	-	-	-	7,400

In each of these cases the rash consisted of a diffuse blush over the body, which disappeared by the fourth day; the sore throat was very slight; and desquamation was of the fine branny character. In neither case were there any complications during convalescence.

SCARLATINA OF MODERATE SEVERITY.

This type of the disease presents to us the most interesting series, for in it we meet with some running an uncomplicated course of scarlet fever, while others develop adenitis, otitis media, and so on, thus giving us several classifications to be considered.

During the first week we may consider all the cases of this type of the disease under the same heading, as up to this time no complications have arisen.

Viewing the leucocytosis as it occurs on the different days, the results are as follows:

Day of Disease	No. of Cases Examined	Average Count
2d - - - - -	1	18,000
3d - - - - -	5	32,260
4th - - - - -	3	33,185
5th - - - - -	2	29,505
6th - - - - -	1	30,670
8th - - - - -	2	23,060

The highest individual count obtained in the above series was 78,133 on the third day of the disease. No reason could be assigned for this high count, as the leucocytes numbered only

28,730 on the fifth day, while the case ran its further course of moderate severity with no complications. The lowest count during the first week was 11,370.

In the above series, it will be seen, the leucocytosis ascends till the fourth day—which just about represents the course of the intensity of the scarlatinal rash.

None of the patients had a temperature above 103.2°, and the highest temperature was usually on the second or third day. The curve of the leucocytes does not follow the temperature curve. While we may note a sudden drop in the fever, this does not denote a consequent fall in the number of leucocytes, which gradually decrease in number till the fourth or fifth week.

From the eighth day on, the cases must be divided under several headings as complications arise:

Pure uncomplicated cases.—Of the uncomplicated cases of moderate scarlatina in the series there were five, in which the counts resulted as follows:

Day of Disease	No. of Cases Examined	Average Count
15th - - - - -	3	15,585
21st - - - - -	3	13,260
25th - - - - -	1	15,270
29th - - - - -	2	12,890
34th - - - - -	1	10,900

The tabulation shows a gradual decrease in the leucocytosis. During this time (from the end of the second week on) the temperature runs a normal course and desquamation is advancing. Desquamation of various intensity showed no change in the white-cell count.

Complicated cases.—One case, complicated with *adenitis* and *otitis media* (suppurative) during the third week, gave an increase in the leucocytosis. The discharge from the ear contained streptococci, staphylococci, and some large bacilli which were not determined.

Day of Disease	Count
15th - - -	14,720
18th - - -	Onset of adenitis and otitis media
19th - - -	18,460
25th - - -	16,250
32d - - -	13,630

Two cases, complicated with *varicella*, gave an increased leu-

cocytosis at the onset of the second disease (the rise in temperature being the first symptom) and before the appearance of the vesicles. The first case occurred on the sixteenth day, with a consequent leucocytosis of 20,470—a rise of nearly 7,000 over an examination three days previously. The second case developed varicella nineteen days after the onset of scarlatina, and showed a leucocytosis of 18,060 on the day previous to the appearance of the vesicles. Forty-eight hours after the appearance of the vesicles, when these were becoming opalescent, while others were dying, the white-cell count amounted to 16,632.

One patient developed a severe *arthritis* on the forty-fourth day after the onset of scarlatina. The ankles, wrists, and knees were particularly affected, while the temperature rapidly rose to 104 and 105°. The leucocyte count up to this time had been that of moderate severity, the highest count being 26,720. The count on the thirtieth day was 14,056; on the forty-fifth day, the day following the onset of the arthritis, this was increased to 32,740. The temperature remained persistently high for some weeks, returning to normal at the end of the ninth week. On the fifty-sixth day the leucocyte count was 18,900, and at the end of the ninth week this fell to 14,348. The patient left the hospital at the end of the tenth week, and although the temperature remained about normal, the arthritis persisted for some time.

MODERATELY SEVERE CASES—DIFFERENTIAL COUNT.

Now, considering the differential count in cases of moderate severity, the following results were obtained:

Period of Disease	No. of Cases	Total No. of Leucocytes Averaged	Maximum No. in Any Case	Minimum No. in Any Case	AVERAGE PERCENTAGE OF		
					Poly-mor-phonuclears	Lymphocytes	Eosinophiles
2d-4th day.....	5	25,130	78,133	11,370	89.1	9.8	1.1
4th-10th day.....	5	29,080	48,270	16,400	85.6	10.7	3.7
10th-16th day.....	4	17,100	22,500	14,940	79.6	13.6	6.8
16th-22d day.....	4	13,080	23,060	9,300	69.2	14.5	16.3
22d-31st day.....	4	14,230	18,240	9,870	58.5	30.9	10.6
35th-42d day.....	3	11,400	13,500	8,900	59.3	47	0.5-4
Normal.....		9,500-10,500			30-50	40-60	0.5-4

The highest eosinophile count during the first week was 4.9 per cent. and the lowest 0.41. The highest polymorphonuclear count during the first week was obtained on the second day of the disease, the count reaching 96.7 per cent. of all cells. The lymphocytes were reduced in this case to 2.89 per cent.

In the early stages of the disease the polymorphonuclear cells show very poor staining qualities, the nuclei being indistinctly outlined. The chromatin films are much broken up and stain unequally. The fine granules outside the nucleus present a hazy purple appearance.

During the second week the highest individual eosinophile count was obtained, on the thirteenth day, there being 19.3 per cent. of these blood elements present. The coarse oxyphile cells stain very intensely; the granules are larger and are packed closely in the cells. The cells seem overburdened with the acidophile granules, and are readily broken in making blood films, in which case the field about the burst corpuscle shows many of these granules extra-cellular and well stained.

Toward the end of the second week the polymorphonuclear leucocytes also change in character. The fine oxyphile granules are now somewhat coarser and take the eosin stain more actively. These cells show their oxyphile character in all grades, from the faintly staining pink cells, whose individual granules can be distinguished, to those that show such intense and coarse staining that they closely resemble the true eosinophile leucocytes. This acid-staining characteristic was noted particularly in the severer cases which had passed the crisis.

From the end of the second week there was a constant decline in the proportion of the polymorphonuclears, while the lymphocytes increased. A lymphocytosis during convalescence was found only in a few instances, the highest proportion being 52.3 per cent. on the thirty-first day of the disease.

The eosinophiles run a course quite different from that of the other leucocytes. During the first few days the count is low, and even at times from day to day decreases, up to the fifth or sixth day, their number from this time on rapidly increasing, till a maximum is reached (in my series of cases) between the four-

teenth and twenty-first days. This initial decline with a secondary rise fairly accurately followed, inversely, the temperature curve, which in turn denotes the existing toxemia. Hence it would seem that during the time of the extensive elaboration of scarlatinal toxins in the body there is a low eosinophile count. From the end of the third week, in nearly all cases, the eosinophiles gradually decrease during convalescence. Slight exacerbations of temperature had no effect on the proportion of the coarse oxyphiles.

The cases complicated with adenitis and otitis media showed an increase mainly in the polymorphonuclears. In acute nephritis the relative count was not constant; the polymorphonuclears were at first slightly increased, while later the lymphocytes rose in proportion to the total number of cells. The eosinophiles were never increased.

MALIGNANT SCARLET FEVER.

In this classification are considered two cases in which the toxic symptoms completely overshadowed all others, the patients becoming comatose within eighteen hours after the onset; and a third in which there was a persistent high temperature until death, at the end of three weeks. In each of the former cases but one count was obtained, death ensuing on the first and third day respectively. In one of these cases the examination was obtained fourteen hours after the onset, and the count amounted to 6,520. The relative count showed a complete absence of eosinophiles, while the polymorphonuclears were present in the proportion of 68.5, and the lymphocytes of 31.45, per cent. The second patient gave a count of 10,832 leucocytes in the proportion of—

	Per cent.
Polymorphonuclears - - - - -	76.0
Lymphocytes - - - - -	24.7
Eosinophiles - - - - -	0.3

The interesting feature in both of the above cases is the small number of leucocytes present, many writers claiming a leucocytosis of 40,000 in malignant scarlatina. The loss in the eosinophiles follows the rule as seen in scarlatina of moderate intensity, in that their numbers are decreased in proportion to the existing toxemia.

The third example of this type of scarlatina suffered with a concomitant diphtheria, which bars any conclusions, as regards scarlet fever, to be drawn from it. At any rate, it is interesting to note that here, too, the leucocyte count was low, ranging (in four counts taken at intervals during three weeks) from 8,340 to 13,860. Also in the relative count the proportion of eosinophiles was reduced, numbering from 0.16 to 0.24 per cent. of the total white cells.

The polymorphonuclear cells stained poorly and did not show the acidophile tendency as seen in the preceding type. The nuclei showed fragmentation—an indistinct outline—and lay close to the periphery of the cell. The nuclei stained a pale blue, and the meshes of the intranuclear arrangement were loose and in many places transparent. The oxyphile granules in the eosinophiles had a washed appearance, as if these granules had partially dissolved in the cell substance which then took the acid stain.

CASES TREATED WITH ANTISTREPTOCOCCIC SERUM.

Two patients who toward the end of the first week of the disease received 30 c.c. antistreptococcic serum were examined. In each case a count was made immediately before the administration, and then a second count four hours after.

The results obtained were as follows:

	CASE I		CASE II	
	Before Admin- istration	Four Hours After	Before Admin- istration	Four Hours After
Total count	17,160	15,520	20,656	16,410
Relative count—				
Polymorphonuclears ..	82.1%	78.3%	88.4%	80.1%
Lymphocytes	16.8	18.3	8.7	12.3
Eosinophiles	1.1	3.4	3.9	7.6

The changes occurring were thus a diminution in the total number of leucocytes and a relative increase in the eosinophiles and lymphocytes. The increase was particularly noticeable in the eosinophiles, which at the same time appeared smaller than normal. No change was noted in the staining qualities of the

different leucocytes. The diminution in the total number of leucocytes, it should be noted, is similar to that seen after the administration of antitoxin in diphtheria.

GENERAL SUMMARY.

Bowie, considering his *mild* cases under scarlatina simplex, obtained as high a count as 34,900. His average, however, in this class varied from 10,000 to 18,850. As a general rule, he states, the slighter cases have a low leucocytosis. In my own series the changes in the white cell elements, in mild scarlatina, are slight. The white cell count rarely reaches 20,000, and falls back to normal in the third, or even the second, week. A leucocytosis of any intensity is not the rule, nor are there marked changes in the proportions of the different leucocytes. As already suggested, the partial want of harmony between the two series would appear to be due to difference in the grade of case dealt with by Bowie and myself under this heading.

GENERAL SUMMARY.

As regards scarlatina of *moderate* severity, the series here recorded shows a constant leucocytosis of high degree—as a rule from 20,000 to 40,000; it may rise as high as 78,000. In this form the leucocytosis is more marked than that seen in either the mild or fatal cases. The height of the leucocytosis is attained on the third or fourth day after the onset of the disease, from which time it gradually falls to normal at the end of the fifth week. The duration of the leucocytosis varies with the severity of the attack, some cases falling to normal in four weeks, others being protracted into the seventh week.

The early changes are the rapid increase in the polynuclears, rising to as much as 93 per cent. of all the cells. Coincident with the increase of the polynuclears there is a fall in the number of lymphocytes. In uncomplicated cases the polynuclears have attained their maximum in the first week, and then gradually decrease, reaching their normal from the third to the fourth week or later according to the severity of the attack. Early in the first week of the disease the eosinophiles are found below the maximal limits of the normal count, and at times below the minimal

limit. Then there is a rapid increase, which, during the second and third week, may attain a proportion of 19 per cent. of the total leucocytes. The cases showing a good resistance to the disease, and in which the prognosis is good, attain the maximum eosinophile count within the first ten days. The normal is again reached toward the end of the fifth week.

These cases of moderate severity appear to represent in part Bowie's series of cases of scarlatina anginosa. In these anginose cases Bowie found that the polynuclears were increased relatively and absolutely at first, attaining as much as 90 per cent. in one case. His highest counts were obtained on the third and fourth days, and in cases where there were no complications normal was again reached at the end of the third week. The eosinophiles, he noted, were decreased during the first few days. This decrease was evident for a greater length of time in the more severe cases, and an increase was evident only when the tissues were obtaining the upper hand of the toxemia.

In my cases I found that the eosinophiles varied according to the severity, not only in number, but also in appearance. In moderately severe cases, where the tissues were gradually overcoming the attack of the toxins, the oxyphile granules were well marked and crystalline in appearance. If the percentage of the eosinophiles is high, the individual cells are smaller than normal; the nucleus is more compact and stains a deep blue. The polymorphonuclear cells show a strong activity for acid stains. The oxyphile characteristic of these cells varies directly with the intensity of the disease along with the resistance exhibited by the body, or conversely. In severe attacks of scarlatina the prognosis is more favorable in those showing a marked oxyphile nature of the polymorphonuclear leucocytes, along with a high eosinophile count.

This matter of degenerative appearances seen in leucocytes at one or other stage of an infective process deserves attention. Until recently but little mention has been made regarding it in the literature. Arneth's paper in the *Deutsche medicinische Wochenschrift*, Nos. 1 and 2, 1904, is the beginning of a fuller study of the subject. For the present, in the absence of wider

knowledge, it seems to me advisable merely to call attention to the fact that degenerative changes of the nature described are to be met with in the leucocytes of scarlet fever, without attempting to discuss their ultimate nature. The accompanying plate gives, as nearly as I can express it, the varieties in the appearance of the oxyphile granules.

Complications and sequelæ of lymphadenitis, arthritis, varicella, and otitis each show an increase of 4,000 to 12,000 in the number of white cells, the polynuclears showing the greatest change. Nephritis may show either an increase or a decrease in the leucocytosis, depending on the stage and severity of the disease it accompanies. Weakly patients who have had a hard struggle with the original scarlatinal intoxication, and whose resistance has not been brought up to a point to throw off a new attack on the kidneys, show a fall in the number of white cells. On the contrary, patients who during convalescence have a transient, more or less severe, attack of nephritis have an increased leucocytosis.

Reverting again to Bowie, he found that all his cases of nephritis showed an increased leucocytosis, but he notes that the cases of short duration and more favorable prognosis have the highest leucocyte count.

Malignant scarlatina—in which I do not include severe complicated cases, but only those which are intensely affected by the scarlatinal toxin alone—tend to show a low total leucocytosis, and also a diminished eosinophile proportion. Compared with the previous type of the disease, it is thus seen that the leucocytosis varies according to the severity of the disease up to a certain limit, when the extreme toxemia either paralyzes the cell-producing organs, or else causes a cytolytic action. At any rate, there is a diminished number of white cells.

In these malignant cases the polymorphonuclear cells do not show the oxyphile character seen in the cases with a favorable prognosis. The indistinct appearance of the oxyphile granules, with the “washed,” pink-stained protoplasm of the few eosinophiles present, would tend to give one the impression that there is cytolysis of this type of cell going on in malignant scarlatina. We no longer find the eosinophiles with the protoplasm densely packed with oxyphile granules, and a deeply stained nucleus.

Bowie lays stress on the low total leucocytosis and the almost total absence of the eosinophiles in unfavorable cases, but he makes no note as to the changes in the staining qualities of the different kinds of cells.

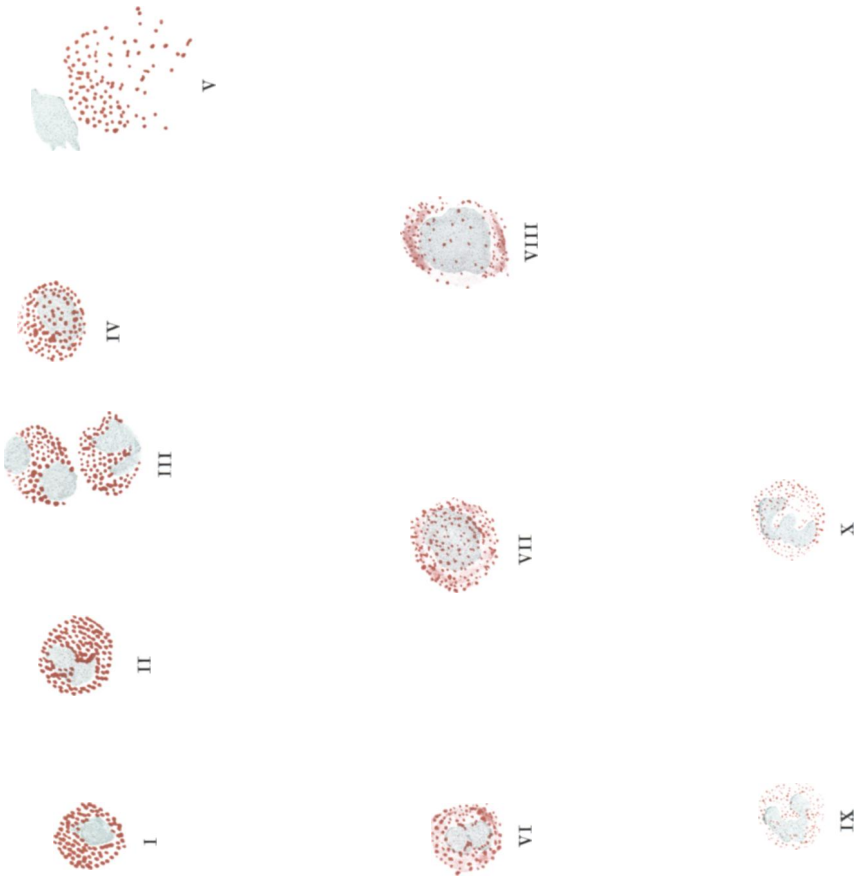
A further study determining the part played by the oxyphile granules is required to clear up the significance of the eosinophilia.

In conclusion, I wish to express my thanks to Dr. Hektoen for valuable references to articles which otherwise would have escaped me, and to Dr. Adami for suggestions and counsel.

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PLATE X.



Nos. I-V, eosinophiles from favorable cases of moderate scarlatina; Nos. I-IV, showing coarse granules crowding the cells; No. V, ruptured cell; Nos. VI-VIII, eosinophiles from malignant scarlatina, oxyphile granules having washed appearance; Nos. IX, X, polymorphonuclears with active oxyphile characters.